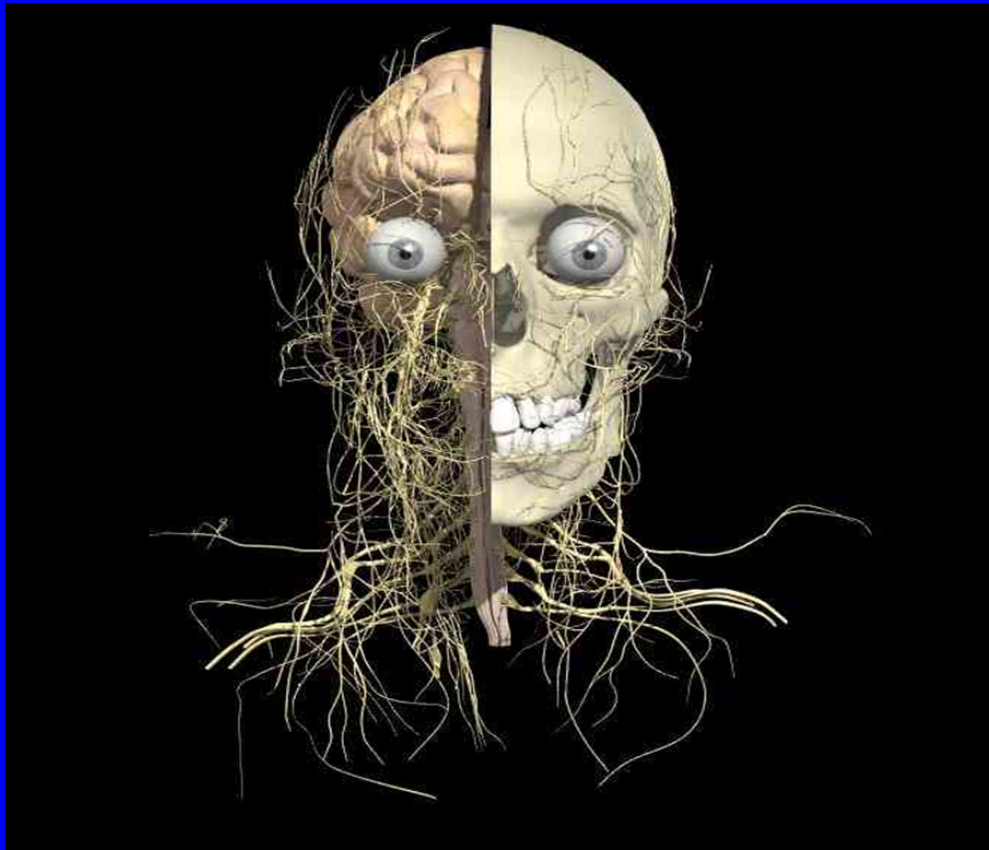


Nerve Impulses



What Is A Nerve Impulse?

- A nerve impulse is a wave that
 - 1. passes along a nerve cell's membrane
 - 2. passes from 1 nerve cell to the next
- It is electrochemical
- It is an all or none response
- A threshold has to be reached to start the impulse (called the threshold limit)

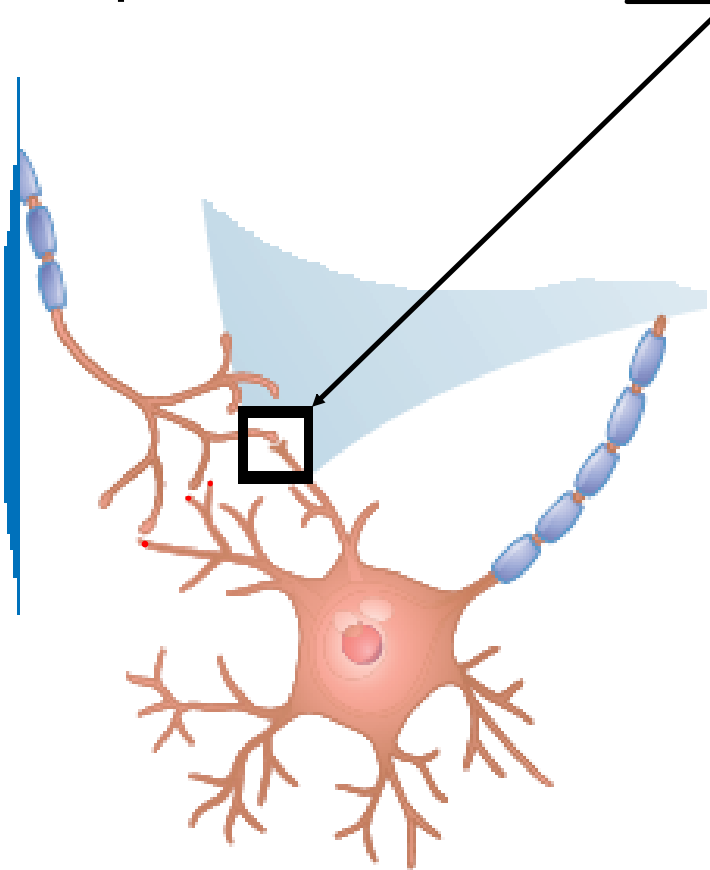
it's a bit like electricity following through a wire but more like a series of dominoes where one falls and the rest follow

<http://www.interactive-biology.com/1541/what-is-an-action-potential-episode-7/>



The Basics of Nerve Impulses

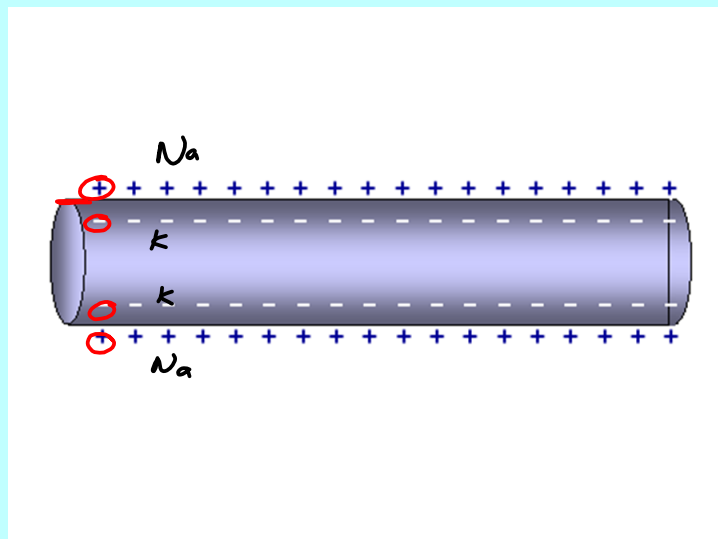
- Nerve cells stuck end-to-end
- Nerve cells do not actually touch each other
- The spaces are called synapses



Transmission of an impulse = Action Potential

The Resting Membrane = no impulse is being transmitted

- it's is polarized - positive on the outside, negative on the inside
- nerve cell membranes are bathed in ions
- sodium ions (Na^+) are on the outside of the membrane and potassium ions (K^+) are on the inside



✱ - although both sodium and potassium have a positive charge the inside of the membrane has a negative charge as a result of negatively charged proteins and nucleic acids on the inside

- the cell membrane is also slightly more permeable to potassium ions (K^+) than sodium so the extra sodium on the outside creates the positive charge

- the nerve receives stimulus which must be strong to break the threshold and cause a change in the voltage charge to
 - 55 mv.
- at this point the Na^+ gates along the membrane open and sodium rushes in
- this is known as **depolarization** as the inside of the cell membrane now has a positive charge
- as more sodium rushes in more gates open and the impulse continues along the cell membrane - like dominoes
- this will continue until the charge on the membrane reaches about +50 mv
- * this is an all or none process (once it begins it doesn't stop)

<http://www.interactive-biology.com/1572/depolarization-phase-1-of-the-action-potential-episode-9/>



- now that the membrane is depolarized, has reached around +50 mv, gated ion channels for potassium open and potassium rushes to the outside (sodium gates close at this voltage)


- the membrane is said to **repolarized** but the positive charge is on the inside and the negative is on the outside

- depolarization and repolarization continue down the axon until it reaches the axon terminal

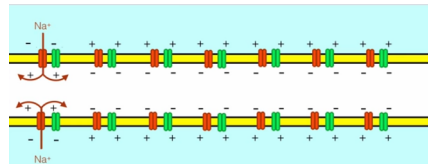
- the impulses don't return toward the beginning because the sodium and potassium gates close to prevent depolarization/repolarization from reoccurring

Restoring the Resting Membrane

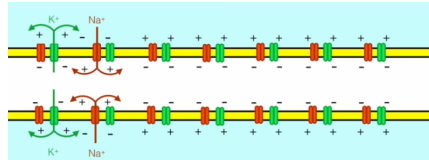
- After nerve impulse passes by, the wrong charges are on the cell membrane (repolarized)
- Neuron works quickly to pump Na^+ out and K^+ back in at 3:2 ratio = active transport because energy is needed
- This restores the resting membrane back to being polarized and its ready to receive another action potential/impulse
- Called the **refractory period**; a time when the neuron cannot receive an impulse

 <http://www.youtube.com/watch?v=HnKMB11ih2o>

Lesson 4 Action Potential.notebook

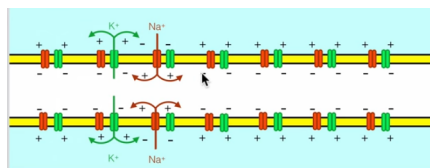


sodium gates open, sodium rushes in
positive charges repel each other, push to left and right



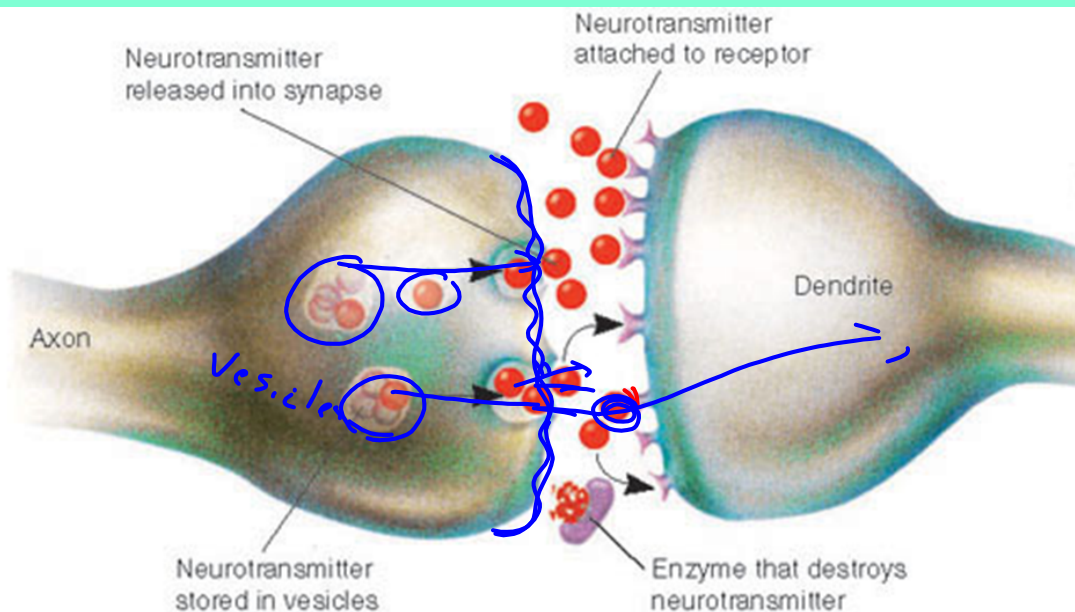
impulse moves right only because sodium gates to the left have closed (voltage has reached about 50 mv.), but sodium gates to the right open and more sodium comes in.

at the same time the potassium gate open to allow potassium out and repolarization to occur



this opening and closing of the gates (depolarization/repolarization) is what cause the impulse to travel along the axon until it reaches the axon terminal - like dominoes

- once an impulse reaches the end of an axon it must cross the synapse to a muscle, gland or another neuron



- neurotransmitters are chemicals that diffuse across the synapse and cause an impulse when they attach to receptors on a muscle, a gland or another neuron (key + lock)

Types of Neurotransmitters

Acetylcholine – stimulates muscle contraction

Monoamines – Norepinephrine & Dopamine (sense of feeling good, low levels = depression)

Serotonin (sleepiness)

Endorphins (reduce pain, inhibit receptors)

Synapses are highly susceptible to drugs and fatigue

https://www.youtube.com/watch?v=OZG8M_IdA1M

<https://www.youtube.com/watch?v=VitFvNvRIIY>

<https://www.youtube.com/watch?v=vPvN7SmLrjs>

<http://www.youtube.com/watch?v=JbClvMz0yvc>

<http://www.interactive-biology.com/1579/repolarization-phase-2-of-the-action-potential-episode-10/>

